OPERATION
AND
SERVICE MANUAL
T.O.S. NO.101C

MODEL VR-50M
PLUG-IN SWEEP GENERATOR

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SERIAL NO.

OPERATION
AND
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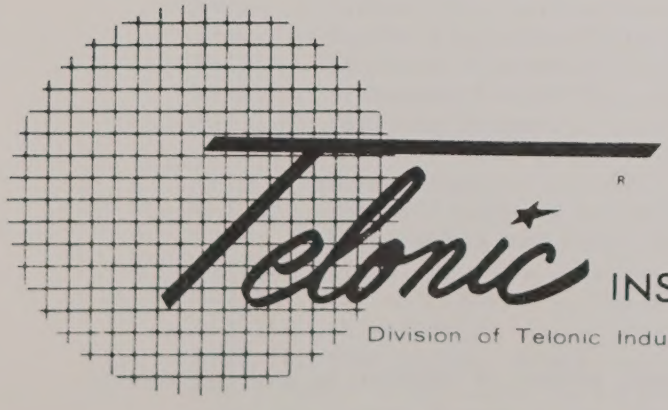
MODEL VR-50M
PLUG-IN SWEEP GENERATOR

This Operation and Service Manual applies to both the VR-50 and VR-50M Plug-in Sweep Generator units.

REVISED MARCH 1967



INSTRUMENTS

Division of Telonic Industries, Inc.

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SECTION I

GENERAL INFORMATION

1-1. SPECIFICATIONS.

1-2. Table 1-1. lists the specifications for the VR-50M PLUG-IN SWEEP GENERATOR.

TABLE 1-1.

Specifications	
Sweep Generator:	
Center Frequency Range-	500 to 1000 MH_z
Sweep Frequency Range-	500 to 1000 MH_z
Sweep Width-	5 to 500 MH_z
Load Requirements-	2.0:1 VSWR maximum at 50Ω
Output Power-	1.8mW (0.3 Volts rms)
Vernier Level Control-	1dB
Amplitude Level Variation-	1.5dB at full sweep width
Linearity-	1.5:1 at full sweep width
Residual FM-	Less than 250 KH_z
Stability (After warmup)	
1 minute-	Less than 1.5 MH_z
1 hour-	Less than 10 MH_z
Variable Marker:	
Frequency Range-	500 to 1000 MH_z
Accuracy-	0.5%
Calibration Marks-	10 MH_z

1-3. DESCRIPTION. (See Figure 1-1.)

1-4. The VR-50M PLUG-IN SWEEP GENERATOR is a solid state modular unit designed for use with Telonic SWEEP/SIGNAL GENERATOR CONTROL CHASSIS SM-2000. The VR-50M provides adjustable sweep widths of 5 to 500 MH_z anywhere within the 500 to 1000 MH_z band.

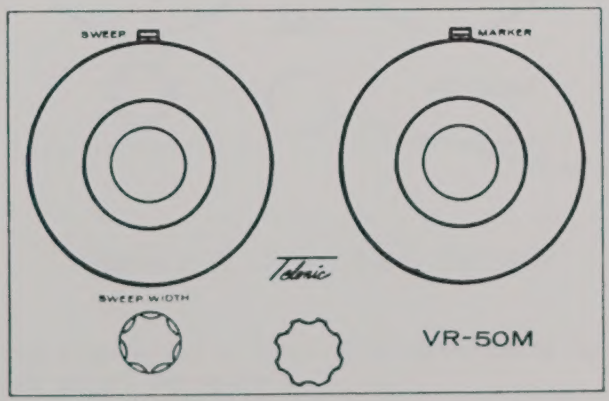


Figure 1-1. VR-50M PLUG-IN SWEEP GENERATOR

SECTION II

OPERATING INSTRUCTIONS

2-1. GENERAL.

2-2. This section provides the complete functional control description and operating instructions for the VR-50M PLUG-IN SWEEP GENERATOR.

2-3. CONTROL PANEL DESCRIPTION. (See figure 2-1.)

2-4. FRONT PANEL. Table 2-1 provides a complete functional description of all Front Panel Controls.

TABLE 2-1.

Front Panel Control Functional Descriptions	
SWEEP-	Provides a calibrated control to vary the center or CW frequency between 500 and 1000 MH_z
MARKER-	Provides a calibrated control to vary the marker frequency between 500 and 1000 MH_z
SWEEP WIDTH-	Provides control to vary the Sweep Width between 5 and 500 MH_z

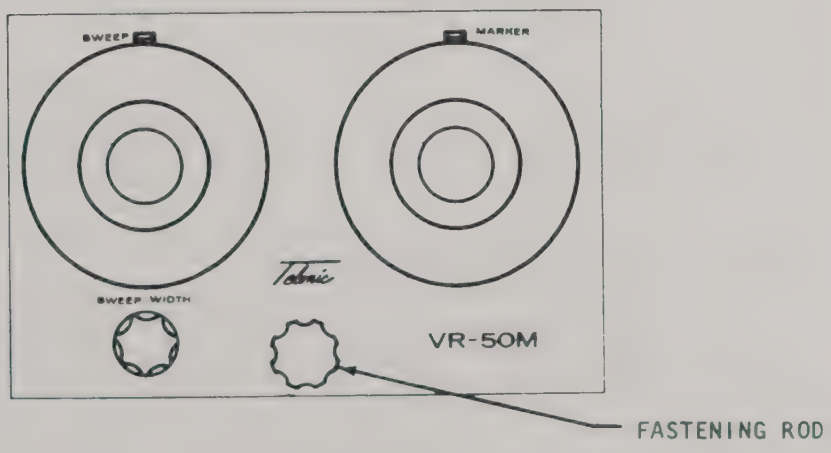


Figure 2-1. Front Panel Controls

2-5. REAR PANEL. (See figure 2-2.) Table 2-2. provides a complete functional description of all rear panel connectors.

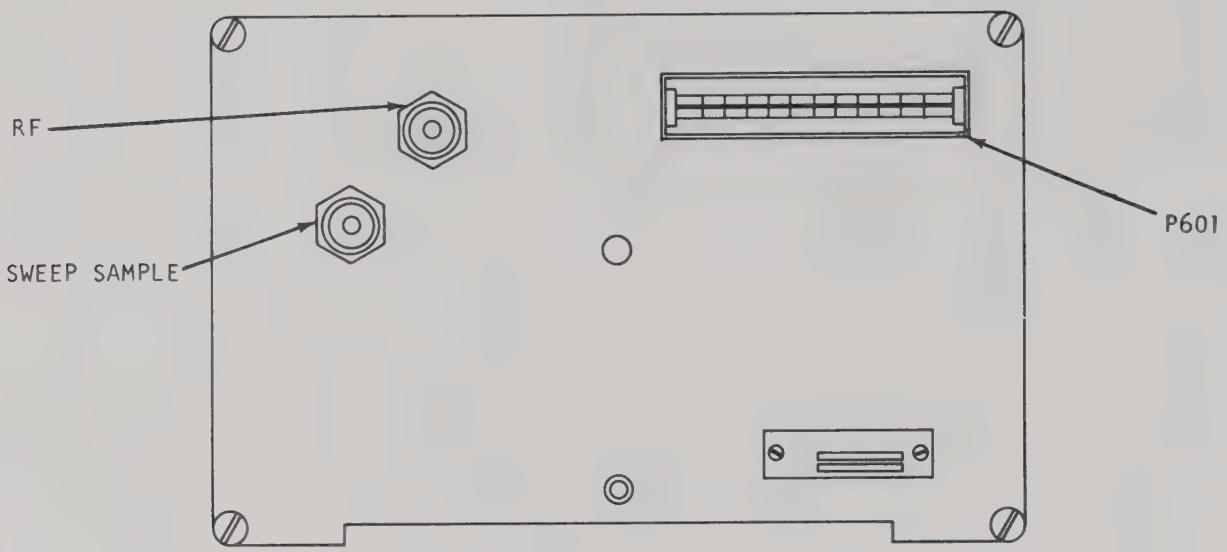


Figure 2-2. Rear Panel Connectors

TABLE 2-2.

Rear Panel Connector Functional Descriptions	
P601-	Provides electrical connection to SM-2000 Control Chassis
RF-	RF output BNC connector
SWEEP SAMPLE	Sweep sample input BNC connector

2-6 PRE-OPERATION.

2-7. The following pre-operation procedure must be performed before operating the VR-50M PLUG-IN SWEEP GENERATOR.

a. Insert the VR-50M in the SM-2000 SWEEP/SIGNAL GENERATOR CONTROL CHASSIS and tighten fastening rod.

CAUTION

Ensure SM-2000 POWER-ON switch is in the Off position before inserting the VR-50M.

b. Connect the SM-2000 to the unit under test as shown in figure 2-3.

NOTE

Attenuation must be provided if the VSWR load exceeds the specification

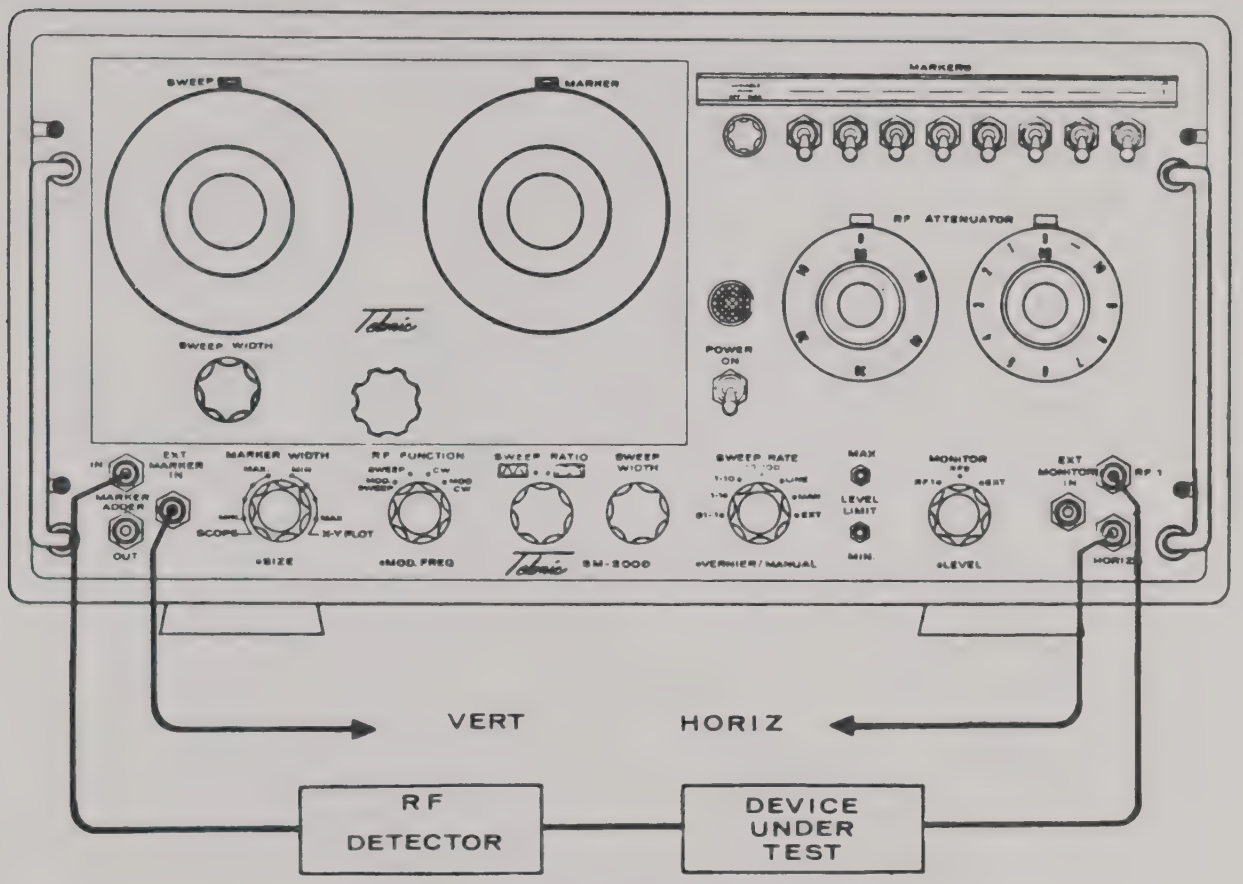


Figure 2-3. Typical Test Connection

2-8. OPERATING PROCEDURE.

a. Refer to the SM-2000 SWEEP/SIGNAL GENERATOR CONTROL CHASSIS INSTRUCTION MANUAL for operating procedure.

CAUTION

Ensure MAX-LEVEL LIMIT control is set to proper RF level

b. Adjust the SWEEP, MARKER and SWEEP WIDTH controls on the VR-50M as required.

NOTE

When operating the SM-2000 Control Chassis in the CW mode the VR-50M SWEEP WIDTH control must be in the full counterclockwise position

SECTION III

PRINCIPLES OF OPERATION

3-1. GENERAL.

3-2. This section provides a brief description of the major circuits of the VR-50M PLUG-IN SWEEP GENERATOR.

3-3. POWER SUPPLY. (See figure 3-1.)

3-4. The SM-2000 SWEEP/SIGNAL GENERATOR CONTROL CHASSIS provides 12.6 VAC to the VR-50M. Step-up transformer T101 is connected to a standard bridge rectifier circuit (CR101, CR102, CR103 and CR104); the output is between 30 to 50 VDC positive and negative, referenced to the center tap of the transformer. The center tap is connected to chassis ground at the sweep oscillator only, to minimize the ground loop hum. Capacitors C101 and C102 filter the rectifier outputs.

3-5. Zener diodes CR112 and CR113 and current limiting resistor R116 establish a reference voltage, which is applied to differental amplifier Q106/Q107. An adjustable output sample voltage is provided by voltage divider R109, R110 and R111, and fed to the differental amplifier. The difference between the reference and sample voltages is amplified and fed to the base of voltage amplifiers Q105 and Q104. The voltage amplifier output is applied to the base of beta multiplier transistor Q102 and series regulator Q101. Diodes CR106 and CR107 provide temperature compensation for the differental amplifier. Variable resistor R110 adjusts the regulated output voltage to +24 volts. Load current flows through current sensing resistor R107 at all times and applies the voltage drop to current limiting transistor Q103.

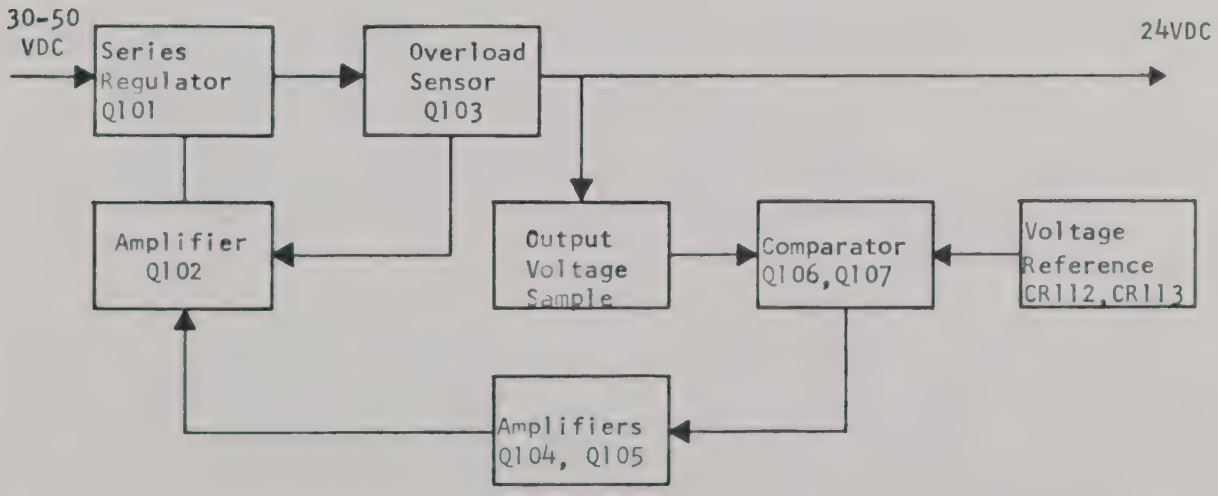


Figure 3-1. Power Supply Block Diagram

3-6. The negative regulator circuit is identical to the positive regulator circuit explained in paragraphs 3-4 and 3-5.

3-7. SWEEP DRIVE CIRCUIT.

3-8. The SM-2000 provides the Sweep drive saw-tooth signal to pin 28 of connector P601. The signal is fed to voltage divider R201, R202, and R203. The voltage divider attenuates the saw-tooth and applies it to the base of emitter-follower Q201. The output signal is fed to voltage divider R205 and R207, which varies the saw-tooth voltage from zero to a preset peak-to-peak level of 6 to 20 volts. Bootstrapped emitter-follower Q202/Q203 provides a low output impedance to prevent loading of the SWEEP WIDTH CONTROL (R207). The dc reference voltage shift from zero is reduced by resistor R208. The saw-tooth sweep drive signal is fed through resistors R217 and R218 to the emitter of Q205 and bootstrapped emitter-follower Q206/Q207, and is fed to the base of current driver Q209. The current saw-tooth is applied to the emitter of high voltage transistor Q208. The drive voltage output from the collector of Q208 is fed to the base of Q211 and a constant current is provided by Q210 to the emitter; this prevents over dissipation by maintaining the collector at a safe level and provides an offset voltage to maintain the drive voltage at the proper voltage level. Variable resistor R202 provides adjustment for the proper dc level. The sweep drive signal limits provided by variable resistor R219 are determined by variable resistors R213 and R217. The d-c voltage applied to the collector of Q208 is provided by the SM-2000 Control Chassis B+2 Power Supply through the Shaper Matrix circuit. The linearity adjustment for the low frequency end of the sweep generator is provided by variable resistor R227.

3-9. SHAPER MATRIX CIRCUIT.

3-10. The Shaper Matrix consists of a series of resistor diode combinations that provide the varicap drive voltage shaping necessary for linear frequency sweep. Resistor R351 determines the initial slope at the minimum collector current of approximately 0.5mA. Diodes CR301 through CR310 are back biased initially to provide the proper conduction sequence. As the collector load current increases, the output voltage will decrease due to the voltage drop across resistor R351, when the output voltage is equal to the back bias voltage, diode CR301 starts to conduct placing resistor R352 and the diode forward resistance in parallel with resistor R351 changing the slope value. This procedure is followed until all the diodes conduct.

3-11. LEVELER CIRCUIT.

3-12. The SM-2000 Control Chassis provides the B+ from its Leveler circuit to pin 31 of connector P601 in the VR-50M. Proper blanking is also provided to pin 31, and fed through voltage dropping resistor R404 to emitter-follower Q401. B- is applied through voltage dropping resistor R403 to the base of emitter-follower Q401, ensuring proper cut-off during blanking. The output of the emitter-follower is fed to the base of series regulator Q402, the emitter is connected to -24 VDC and the collector to the sweep oscillator B- terminal. Load resistor R402 and "turn-on" capacitor C402 provides fast oscillator rise time. Negative feedback from this circuit is provided by resistor R401 and capacitor C401.

3-13. MARKER POWER CIRCUIT.

3-14. The SM-2000 vari-rate circuit, Schmitt trigger, receives B+2 through connector P601 and load resistor R504 in the VR-50M.

3-15. When the VARIABLE MARKER switch on the SM-2000 Control Chassis is in the ON position + 100 VDC is provided through connector P601 to voltage divider resistors R501/R502 and transistor Q501. The collector of Q501 provides -24 VDC directly to the variable marker in the VR-50M. The emitter of Q501 is connected through current limiter resistor R503 directly to the -24 VDC from the VR-50M power supply. When the VARIABLE MARKER Switch on the SM-2000 is in the OFF position -24 VDC bias is applied to the base of Q501.

3-16. SWEEP OSCILLATOR.

3-17. Sweep oscillator Q801/Q802 and associated circuits provide output frequencies in the 500 to 1000 MH_Z range to the SM-2000 Control Chassis. Varicaps CR801 and CR802 vary the sweep frequency range.

3-18. MARKER OSCILLATOR.

3-19. The Marker Oscillator is a mechanical tuned oscillator identical to the Sweep Oscillator described in paragraph 3-16.

3-20. MIXER CIRCUIT.

3-21. The Marker input signal of 500-1000 MH_Z is fed through coupling capacitor C701 to mixer diode CR701. The Sweep sample signal is fed through attenuator pad R701, R702 and R703 to the mixer.

3-22. The output of diode CR701 is filtered by R-C low-pass filter, R705 and C702. The birdy output of the filter is fed through coupling capacitor C703, and amplified by birdy amplifier transistor Q701; the output of Q701 is coupled by capacitor C705 to the birdy output terminal.

3-23. Resistor R704 provides a dc return path for the mixer diode. Resistor R706 applies the proper bias to the base of transistor Q701. Collector load resistor R707 provides the load to the -24 VDC Marker Power input voltage.

SECTION IV

MAINTENANCE

4-1. GENERAL.

4-2. This section provides complete information for the troubleshooting and maintenance of the VR-50M PLUG-IN SWEEP GENERATOR.

4-3. REQUIRED TEST EQUIPMENT.

4-4. The following test equipment will be required to perform maintenance on the VR-50M.

a.	Sweep/Signal Generator Control Chassis	Telonic SM-2000
b.	Voltmeter	Simpson 270 or equivalent
c.	Precision Ammeter	Universal AVO or equivalent
d.	Oscilloscope	Tektronix 547A or equivalent
e.	Detector	Telonic XD-23A or equivalent
f.	UHF Marker Oscillator	HP612A or equivalent
g.	Harmonic Markers	Telonic CDH50, CDH5, CDH10, CDH1 or equivalent

4-5. PERFORMANCE CHECK.

4-6. This performance check may be used as a routine maintenance procedure or as an incoming inspection to varify the performance of the VR-50M.

4-7. INITIAL SETUP.

a. Remove all plug-in modules from the VR-50M.

b. Plug the VR-50M into the SM-2000 Control Chassis.

CAUTION
Ensure the SM-2000 POWER-ON switch is in the Off position.

4-8. POWER SUPPLY. (Refer to figure 4-1.)

a. Set the voltmeter to the 50V, -DC scale.

b. Connect the voltmeter (+) lead to the -24V terminal on the VR-50M Power Supply, and the common lead to the Ground terminal.

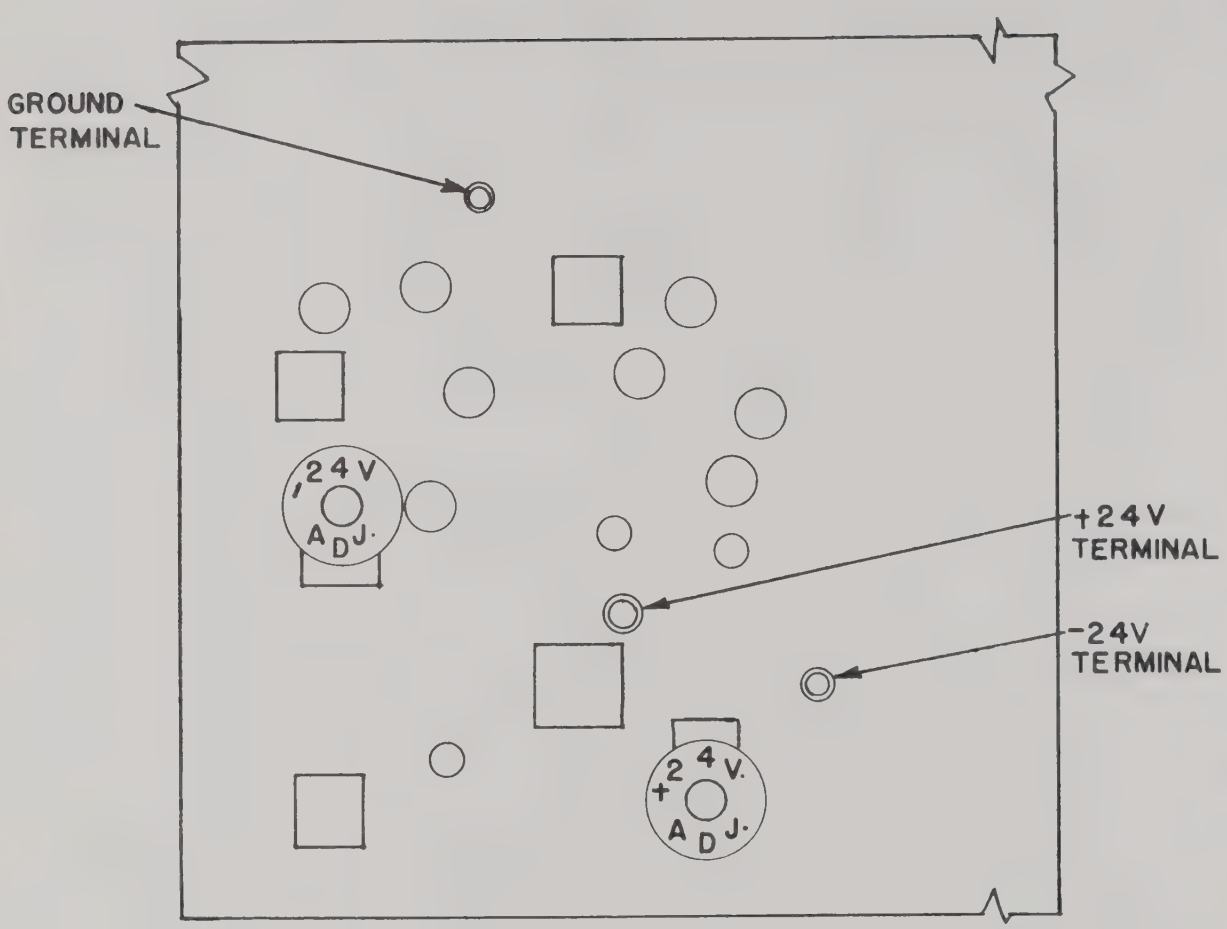


Figure 4-1. Main Circuit Board Component Location

c. Set the SM-2000 POWER-ON switch to the ON position.

d. Observe the voltmeter indication; it should be -24 VDC.

e. Remove the voltmeter (+) lead from the -24V terminal.

f. Set the voltmeter to the 50V, +DC scale.

g. Connect the voltmeter (+) lead to the +24V terminal on the VR-50M Power Supply. Observe the voltmeter indication; it should be +24 VDC.

h. Disconnect the voltmeter.

j. Set the AVO meter to the 10 amp DC scale.

k. Set the SM-2000 POWER-ON switch to the Off position.

l. Connect the AVO (+) lead to the +24V terminal on the VR-50M Power Supply and the (-) lead to the Ground terminal.

m. Set the SM-2000 POWER-ON switch to the ON position. Observe the meter indication; it should be 600 ± 100 mA.

CAUTION

Do not leave SM-2000 POWER-ON switch in ON position for more than 30 seconds.

n. Set the SM-2000 POWER-ON switch to the Off position.

p. Disconnect the AVO meter and reconnect the (-) lead to the -24V terminal and the (+) lead to the Ground terminal on the VR-50M Power Supply.

q. Set the SM-2000 POWER-ON switch to the ON position. Observe the meter indication; it should be 600 ± 100 mA.

CAUTION

Do not leave SM-2000 switch in the ON position for more than 30 seconds.

r. Set the SM-2000 POWER-ON switch to the Off position, and disconnect the AVO meter.

4-9. SWEEP CENTER FREQUENCY CALIBRATION

a. Install all plug-in modules in the VR-50M.

b. Set the SM-2000 POWER-ON switch to the ON position.

NOTE

Allow 15 minutes warmup.

c. Connect the SM-2000, detector, and oscilloscope as shown in figure 4-2.

d. Adjust the oscilloscope as follows:

(1) Horizontal Drive - External

(2) Horizontal Gain - 10 cm display

(3) DC Vertical Gain - 0.1V/cm

e. Set the RF FUNCTION switch on the SM-2000 to the SWEEP position and the SWEEP RATE switch to the LINE position.

f. Set the 50 MH_Z Marker switch on the SM-2000 to the On position.

g. Adjust the SWEEP WIDTH control on the VR-50M for a 50 MH_z sweep width.

h. Connect the UHF Marker Oscillator to the EXT MARKER IN jack on the SM-2000.

j. Set the VARIABLE MARKER control on the SM-2000 to the On position.

k. Locate the 500 MH_z marker with the UHF Marker Oscillator.

l. Rotate the SWEEP control on the VR-50M to place the 500 MH_z marker in the center of the oscilloscope screen.

m. Observe the SWEEP dial reading; it should read 500 MH_z.

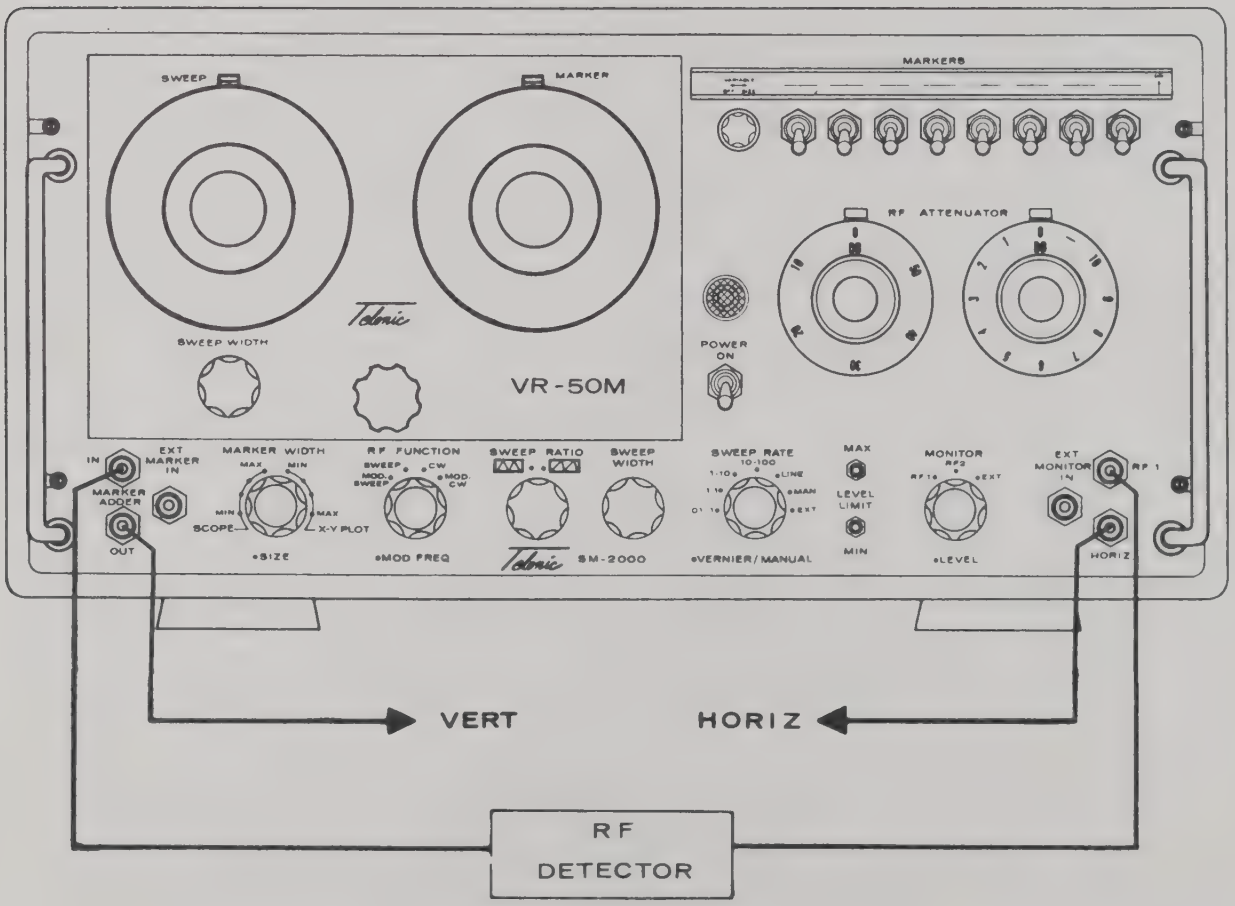


Figure 4-2. Performance Check Test Connections

n. Rotate the SWEEP control on the VR-50M to place the 1000 MH_z marker in the center of the oscilloscope screen and observe the dial setting; it should read 1000 MH_z.

p. Set the VARIABLE MARKER control on the SM-2000 to the Off position.

4-10. SWEEP WIDTH.

a. Set the RF FUNCTION switch on the SM-2000 to the SWEEP position and the SWEEP RATE switch to the LINE position.

b. Rotate the SWEEP WIDTH control on the VR-50M to the full clockwise position.

c. Set the 50 MH_z Marker switch on the SM-2000 to the On position.

d. Locate and center the 750 MH_z marker on the oscilloscope screen.

e. Observe the location of the 500 MH_z marker on the oscilloscope screen; it should be at the left edge of the oscilloscope trace.

f. Observe the location of the 1000 MH_z marker on the oscilloscope screen; it should be at the right edge of the oscilloscope trace.

4-11. OUTPUT

a. Repeat paragraph 4-10 steps a and b.

b. Rotate the MAX LEVEL LIMIT control and LEVEL control on the SM-2000 to the full clockwise position.

c. Observe the minimum output voltage within the 500 to 1000 MH_z band; it should be at least 0.3 VDC.

4-12. FLATNESS.

a. Repeat paragraph 4-10 steps a and b.

b. Repeat paragraph 4-11 step b.

c. Rotate the LEVEL control counterclockwise until the output levels at 0.3 VDC.

d. Locate the maximum and minimum output points within the 500 to 1000 MH_z band. Note the vertical difference; it should not exceed 0.6 cm.

NOTE

This procedure may be used to measure the flatness over any sweep range within the 500 to 1000 MH_z band.

4-13. LINEARITY.

a. Repeat paragraph 4-10 steps a,b and c.

b. Repeat paragraph 4-12 step c.

c. Locate the shortest 50 MH_Z marker interval between 500 and 1000 MH_Z.

d. Adjust the oscilloscope Horizontal Gain until this interval is exactly one cm.

e. Locate the longest marker interval within the 500 to 1000 MH_Z band and note the length; it should be less than 1.5 cm.

f. Adjust the oscilloscope Horizontal Gain for a 10 cm wide trace.

g. Adjust the SWEEP and SWEEP WIDTH controls on the VR-50M for a 500 to 550 MH_Z sweep display.

h. Set the 5 MH_Z Marker switch on the SM-2000 to the On position.

j. Locate the shortest 5 MH_Z marker interval within the 500 to 550 MH_Z range.

k. Adjust the oscilloscope Horizontal Gain until this interval is exactly one cm.

l. Locate the longest marker interval within the 500 to 550 MH_Z range and note the length; it should be less than two cm.

m. Adjust the oscilloscope Horizontal Gain for a 10 cm wide trace.

NOTE

This method may be used to measure the linearity within any 50 MH_Z segment of the 500 to 1000 MH_Z band.

4-14. CENTER FREQUENCY VARIATION WITH SWEEP WIDTH.

a. Repeat paragraph 4-10 step a.

b. Repeat paragraph 4-12 step c.

c. Rotate the SWEEP WIDTH control on the VR-50M to the full counter-clockwise position.

d. Set the 50 MH_Z Marker switch on the SM-2000 to the On position.

e. Locate the 750 MH_Z marker.

f. Adjust the SWEEP control on the VR-50M to place the 750 MH_z marker in the center of the sweep display.

g. Rotate the SWEEP WIDTH control on the VR-50M to the full clockwise position, and note the position of the 750 MH_z marker; it should not shift more than 0.1 cm.

4-15. RESIDUAL FREQUENCY MODULATION.

a. Repeat paragraph 4-10 steps a and b.

b. Repeat paragraph 4-12 step c.

c. Adjust the SWEEP and SWEEP WIDTH controls on the VR-50M for a 500 to 505 MH_z sweep display.

d. Set the 1 MH_z Marker switch on the SM-2000 to the On position.

e. Set the SWEEP RATE switch on the SM-2000 to the 10-100 position.

f. Adjust the SWEEP RATE VERNIER control on the SM-2000 until the flutter on the 1 MH_z markers can be easily seen. The amplitude of this flutter should be less than 0.5 cm.

NOTE

A flutter amplitude of 0.5 cm represents Residual Frequency modulation of 250 KH_z.

4-16. FREQUENCY STABILITY.

NOTE

Allow one hour warmup before performing this test.

a. Repeat paragraph 4-10 steps a and b.

b. Repeat paragraph 4-12 step c.

c. Set the 10 MH_z Marker switch on the SM-2000 to the On position.

d. Adjust the SWEEP and SWEEP WIDTH controls on the VR-50M for a 500 to 520 MH_z sweep display.

e. Set the SWEEP control on the VR-50M to 1000 MH_z for a period of five minutes.

f. Adjust the SWEEP control on the VR-50M to place the 510 MH_z marker in the center of the oscilloscope screen.

(1) After one minute of operation, observe the marker drift; it should be less than 0.75 cm.

(2) After one hour of operation, observe the marker drift; it should be less than 5 cm.

4-17. VARIABLE MARKER.

a. Repeat paragraph 4-10 steps a and b.

b. Repeat paragraph 4-12 step c.

c. Set the 50 MH_Z Marker switch on the SM-2000 to the On position.

d. Rotate the SWEEP control on the VR-50M to place the 500 MH_Z marker in the center of the oscilloscope screen.

e. Set the MARKER WIDTH switch on the SM-2000 to the SCOPE MAX position.

f. Adjust the SWEEP WIDTH control on the VR-50M so that the 500 MH_Z marker is one cm wide.

g. Set the VARIABLE MARKER switch on the SM-2000 to the On position.

h. Adjust the MARKER dial on the VR-50M so that the variable marker and the 500 MH_Z marker coincide.

j. Note the MARKER dial reading; it should read 500 ± 1.25 MH_Z.

k. Rotate the SWEEP control on the VR-50M to the high frequency end of the dial; locate and center the 1000 MH_Z marker.

l. Adjust the MARKER dial on the VR-50M so that the variable marker and the 1000 MH_Z marker coincide.

m. Note the MARKER dial reading; it should read 1000 ± 2.5 MH_Z.

NOTE

Ensure that the variable marker signal is the fundamental and not the second harmonic.

4-18. ALIGNMENT PROCEDURE.

4-19. POWER SUPPLY. (Refer to figure 4-1.)

a. Set the voltmeter to the 50 volt - DC range.

b. Connect the voltmeter (+) lead to the -24V terminal on the VR-50M Power Supply, and the common lead to the Ground terminal.

c. Set the POWER-ON switch on the SM-2000 to the ON position.

d. Adjust the -24V ADJ potentiometer (R126)for a meter indication of -24 volts.

e. Remove the (+) meter lead from the -24V terminal.

f. Set the voltmeter to the 50 volt + DC range.

g. Connect the (+) meter lead to the +24V terminal on the VR-50M Power Supply.

h. Adjust the +24V ADJ potentiometer (R110) for a meter indication of +24 volts.

j. Disconnect the voltmeter.

4-20. CENTER FREQUENCY VARIATION WITH SWEEP WIDTH.

a. Set the POWER-ON switch on the SM-2000 to the ON position.

NOTE

Allow 15 minutes warmup.

b. Connect the SM-2000, detector and oscilloscope as shown in figure 4-2.

c. Adjust the oscilloscope as follows:

1. Horizontal Drive - External

2. Horizontal Gain - 10 cm display

3. DC Vertical Gain - 0.1 V/cm

d. Set the 50 MH_z Marker switch on the SM-2000 to the On position.

e. Rotate the SWEEP WIDTH control on the VR-50M to the full clockwise position.

f. Set the RF FUNCTION switch on the SM-2000 to the SWEEP position and the SWEEP RATE switch to the LINE position.

g. Locate the 750 MH_z marker.

h. Rotate the SWEEP WIDTH control on the VR-50M to the full counterclockwise position.

j. Rotate the SWEEP control on the VR-50M until the 750 MH_z marker is in the exact center of the oscilloscope screen.

k. Rotate the SWEEP WIDTH control on the VR-50M to the full clockwise position.

l. Adjust the DC REF ADJ potentiometer (R202) to place the 750 MH_z marker in the exact center of the oscilloscope screen.

m. Rotate the SWEEP WIDTH control on the VR-50M to the full counterclockwise position. Observe the oscilloscope indication, the 750 MH_z marker should be centered.

NOTE

If the proper indication is not observed repeat steps j through m.

n. Perform alignment procedures specified in paragraphs 4-21 and 4-22.

4-21. SWEEP WIDTH AND SWEEP CENTER FREQUENCY CALIBRATION.

a. Repeat paragraph 4-20 steps a through f.

b. Adjust the LEVEL control on the SM-2000 for 0.3 volts minimum output.

c. Locate the 500 and 1000 MH_z markers.

d. Adjust the SWEEP control on VR-50M and the SWEEP WIDTH LIMIT potentiometer (R205), until the 500 to 1000 MH_z trace is 10 cm wide.

e. Set the SWEEP WIDTH control to the full counterclockwise position.

f. Adjust the SWEEP control on the VR-50M to the 500 MH_z position.

g. Adjust the LOW FREQ CALIB potentiometer (R213) to center the 500 MH_z marker on the oscilloscope screen.

h. Set the SWEEP control on the VR-50M to the 1000 MH_z position.

j. Adjust the HIGH FREQ CALIB potentiometer (R217) to center the 1000 MH_z marker on the oscilloscope screen.

4-22. LINEARITY.

a. Repeat paragraph 4-20 steps a through f.

b. Adjust the LEVEL control on the SM-2000 for 0.3 volts minimum output.

c. Rotate the SWEEP control on the VR-50M to place the 750 MH_z marker in the center of the oscilloscope screen.

d. Adjust the SWEEP WIDTH LIMIT potentiometer (R205) to place the 1000 MH_z marker 5 cm to the right of the 750 MH_z marker.

NOTE

Keep the 750 MH_z marker centered.

e. Adjust the LINEARITY potentiometer (R227) to place the 500 MH_z marker 5 cm to the left of the 750 MH_z marker.

f. Repeat steps d and e until the 750 MH_z marker is centered and the 500 and 1000 MH_z markers are 5 cm to the left and right respectively.

4-23. VARIABLE MARKER.

a. Repeat paragraph 4-20 steps a through f.

b. Set the SWEEP control on the VR-50M to 500 MH_z.

c. Set the MARKER WIDTH switch on the SM-2000 to the MAX SCOPE position.

d. Adjust the SWEEP WIDTH control on the VR-50M until the 500 MH_z marker is 1 cm wide.

e. Set the VARIABLE MARKER switch on the SM-2000 to the On position and set the gain to mid-range.

f. Adjust the MARKER control on the VR-50M until the variable marker coincides with the 500 MH_z marker.

g. Loosen the setscrew on the variable marker front panel drive unit, so that the MARKER dial may be rotated without changing the marker frequency.

h. Set the Marker Dial to 500 MH_z and tighten the setscrew.

j. Set the SWEEP control on the VR-50M to 1000 MH_z.

k. Set the MARKER control on the VR-50M to 1000 MH_z.

l. Adjust the HIGH FREQ CALIB screw on the variable marker until the variable marker coincides with the 1000 MH_z marker.

m. Tighten the lock-nut on the HIGH FREQ CALIB screw.

4-24. TROUBLESHOOTING.

4-25. Refer to table 4-1 for complete troubleshooting procedures; ensure that the SM-2000 SWEEP/SIGNAL GENERATOR CONTROL CHASSIS is operating properly before starting troubleshooting procedure.

4-26. Troubleshoot the Power Supply before proceeding to other circuits.

4-27. PRINTED CIRCUIT BOARDS.

4-28. REPAIR. Printed circuit damage generally is confined to separation or fusion of the copper foil. The following procedure is recommended for repairing this type of damage.

a. Carefully remove the separated copper foil with tweezers.

Table 4-1.

Trouble Shooting Chart				
Proc No.	Trouble	Normal Indication	Test Point	Probable Cause of Failure
1.	Improper power transformer output	30 to 50 VRMS	AC leads on CR101, CR102, CR103 and CR104 rectifiers	1. Check connector P601 2. Check transformer T101
2.	Improper bridge rectifier assy output	± 30 to 50 VDC	± leads on CR101, CR102, CR103 and CR104 rectifiers	1. Repeat Procedure No. 1. 2. Check bridge rectifier assembly CR101, CR102, CR103 and CR104. 3. Check rectifier filters C101 and C102.
3.	Improper positive power supply output	+ 24 VDC	+24V terminal	1. Repeat procedures, No. 1 and 2. 2. Check Series Regulator transistor Q101. 3. Check Zener Diodes CR112 and CR113 and associated circuits. 4. Check Differental Amplifier Q106/Q107 and associated circuits. 5. Check voltage Amplifiers Q104 and Q105 and associated circuits. 6. Check Beta Multiplier transistor Q102 and associated circuits. 7. Check Current Limiting transistor Q103 and associated circuit.
4.	Improper negative power supply output	-24 VDC	-24V terminal	1. Repeat procedures No. 1 and 2. 2. Check Series Regulator transistor Q108. 3. Check Zener Diodes CR114 and CR115 and associated circuits. 4. Check Differental Amplifier Q113 and Q114 and associated circuits. 5. Check Voltage Amplifier Q110 and Q111 and associated circuits. 6. Check Beta Multiplier transistor Q109 and associated circuit.. 7. Check Current Limiting transistor Q112 and associated circuit.

Table 4-1. (cont)

Proc No.	Trouble	Normal Indication	Test Point	Probable Cause of Failure
5.	Improperly leveled sweep output	Leveled sweep output	SM-2000 RF 1 output BNC connector	1. Check Series Regulator transistor Q402 and associated circuits. 2. Check emitter-follower transistor Q401 and associated circuits.
6.	Improper sweep drive output	500-1000 MH_z	SM-2000 RF 1 output BNC connector	1. Check Connector P601 2. Refer to paragraph 4-19 Alignment Procedure 3. Refer to Table 4-2, Voltage checks 4. Check diodes CR101 through CR110 and associated resistors.
7.	Improper marker output	500-1000 MH_z birdy.	SM-2000 RF 1 output BNC connector	1. Check connector P601. 2. Check Marker Power transistor Q501 and associated circuits. 3. Check Marker Oscillator transistors Q901/Q902 and associated circuits. 4. Check Marker Mixer transistor Q701 and associated circuits.
8.	Improper sweep sample	500-1000 MH_z	J206	1. Check J206 BNC connector and coaxial cable.

TABLE 4-2.

Sweep Drive Voltage Indications				
NOTE The SWEEP WIDTH control on the VR-50M must be in the full counterclockwise position when making the measurements specified.				
SWEEP Control Setting	500 MH_z VDC		1000 MH_z VDC	
Transistors	Emitter	Collector	Emitter	Collector
Q201	0	+20.0	0	+20.0
Q202	-0.5	-20.0	-0.5	-20.0
Q203	-20.5	-0.5	-20.5	-0.5
Q204	-20.0	-11.0	-20.0	-11.0
Q205	-10.5	-22.0	-10.5	-22.0
Q206	-11.0	+23.0	-1.0	+22.5
Q207	+23.5	-11.0	+23.0	-1.0
Q208	-0.5	+15.0	-0.5	+140.0
Q209	-10.5	-23.0	-0.5	-24.0
Q210	-12.0	0	-12.0	+125.0
Q211	+14.5	+165.0	+140.0	+165.0

b. Drill a small hole through the board at the ends of the conductors on each side of the remaining gap.

c. Make parallel right angle bends in a piece of tinned hookup wire at points separated by the same distance as the two holes.

d. Clean the area around the holes with varnish remover and wipe with isopropyl alcohol.

e. When dry, apply liquid flux to the area.

f. Insert the hookup wire through the drilled holes.

g. Solder hookup wire in place.

h. Clip off extra length of wire flush with reverse side of the board, using crimping end cutters.

j. Spray area with varnish.

4-29. COMPONENT REPLACEMENT.

CAUTION

Care must be exercised in replacing components mounted on printed circuit boards to prevent damage to other components and the board.

a. Using round-nose pliers, grasp in turn each lead of the component to be removed, apply well tinned soldering iron until solder is melted, and remove the lead from the mounting holes.

b. Melt solder in area around and over each hole in turn, insert aluminum wire or toothpick into hole, and remove soldering iron immediately. When solder resolidifies, remove wire or toothpick.

c. Replace the component as specified in paragraph 4-28 steps c through j.

SECTION V

PARTS LIST

5-1. GENERAL.

5-2. This section provides the complete electrical parts list and component numbering system for the VR-50M PLUG-IN SWEEP GENERATOR.

5-3. COMPONENT NUMBERING SYSTEM. Table 5-1 specifies the numbering sequence used for each circuit board in the VR-50M.

TABLE 5-1

Numbering Sequence	
100-199	Power Supply
200-299	Sweep Drive
300-399	Shaper
400-499	Leveler
500-599	Marker Power
600-699	Not Assigned
700-799	Mixer
800-899	Sweep Oscillator
900-999	Variable Marker Oscillator

5-4. ELECTRICAL PARTS LIST. Table 5-2 provides the complete electrical parts list for the VR-50M.

TABLE 5-2

Electrical Parts List

Circuit Reference No.	Description	Telonic Part No.
C101	CFE, 500µf, 50V	C-334
C102	Same as C101	
C103	CFE, 10µf, 50V	C-341
C104	Same as C103	
C105	CFC, 350 pf, 1000V	C-17
C106	CFC, 470 pf, 1000V	C-18
C107	CFE, 10µf, 25V	C-335
C108	Same as C107	
C109	CFE, 75µf, 25V	C-338
C110	Same as C109	
C111	Same as C101	
C112	Same as C101	
C113	Same as C106	
C401	CFE, 1000pf, 1000V	C-19
C402	CFC, .01µf, 500V	C-20
C403	Same as C402	
C701	Same as C106	
C702	Same as C401	
C703	Same as C402	
C704	CFCF, 470pf, 500V	C-111
C705	Same as C402	
C706	Same as C704	
C801	Same as C704	
C802	CFC, 1000pf, 200V	C-161
C803	Same as C704	
C804	Not Assigned	
C805	Same as C704	
C901	Same as C704	
C902	Same as C704	
CR101	DS, FW100	D-27
CR102	PO CR101	
CR103	PO CR101	
CR104	PO CR101	
CR105	DS, TEL 101	D-24
CR106	Same as CR105	

TABLE 5-2 (Cont)

CR107	Same as CR105	
CR108	Same as CR105	
CR109	Same as CR105	
CR110	Same as CR105	
CR111	Same as CR105	
CR112	DS, 1N708	D-48
CR113	Same as CR112	
CR114	Same as CR112	
CR115	Same as CR112	
CR301	DS, ED 3005	D-7
CR302	Same as CR301	
CR303	Same as CR301	
CR304	Same as CR301	
CR305	Same as CR301	
CR306	Same as CR301	
CR307	Same as CR301	
CR308	Same as CR301	
CR309	Same as CR301	
CR310	Same as CR301	
CR701	DS, 1N82	D-1
CR801	DS, VA-313	D-43
CR802	Same as CR801	
L801	IF, 0.68 µh	L-103
L802	IF, 4.7 µh	L-126
L803	Same as L802	
L804	IF, (SC)	
L901	IF, 10 µh	L-124
L902	IF, (SC)	
Q101	TR, 2N1702	Q-13
Q102	TR, 2N3568	Q-32
Q103	Same as Q102	
Q104	Same as Q102	
Q105	TR, 2N3645	Q-37
Q106	TR, 2N2925	Q-24
Q107	Same as Q106	
Q108	Same as Q101	
Q109	Same as Q102	
Q110	Same as Q105	
Q111	Same as Q105	
Q112	Same as Q102	
Q113	Same as Q106	
Q114	Same as Q106	

TABLE 5-2 (Cont)

Q201	TR, 2N3568	Q-32
Q202	TR, 2N3645	Q-37
Q203	Same as Q201	
Q204	Same as Q201	
Q205	Same as Q202	
Q206	Same as Q201	
Q207	Same as Q202	
Q208	TR, 2N3440	Q-26
Q209	Same as Q202	
Q210	Same as Q208	
Q211	Same as Q208	
Q401	TR, 2N3568	Q-32
Q402	TR, 2N1702	Q-13
Q501	TR, 2N3568	Q-32
Q701	TR, 2N3645	Q-37
Q801	TR, K2501	Q-33
Q802	Same as Q801	
Q901	TR, K2501	Q-33
Q902	Same as Q901	
R101	RFC, 220Ω, ±10%, 1/4w	R-1400
R102	RFC, 15kΩ, ±10%, 1/4w	R-1434
R103	Same as R102	
R104	RFC, 100Ω, ±10%, 1/4w	R-1421
R105	RFC, 1kΩ, ±10%, 1/4w	R-1427
R106	Same as R105	
R107	RFC, 1Ω ±10%, 1/2w	R-150
R108	RFC, 4.7kΩ, ±10%, 1/2w	R-1430
R109	RFC, 5.6kΩ, ±10%, 1/4w	R-1495
R110	RVDC, 5kΩ, ±20%, 1/4w	R-1767
R111	RFC, 3.3kΩ, ±10%, 1/4w	R-1496
R112	Same as R108	
R113	Same as R108	
R114	Same as R108	
R115	Same as R105	
R116	Same as R111	
R117	Same as R102	
R118	Same as R102	
R119	Same as R105	
R120	Same as R105	

TABLE 5-2 (Cont)

R121	Same as R102	
R122	Same as R105	
R123	RFC, 2.7Ω, ±10%, 1/2w	R-126
R124	RFC, 5.6Ω, ±10%, 1/2w	R-132
R125	Same as R109	
R126	Same as R110	
R127	Same as R111	
R128	Same as R105	
R129	Same as R108	
R130	Same as R108	
R131	RFC, 10kΩ, ±10%, 1/4w	R-1494
R132	Same as R105	
R133	Same as R111	
R134	Same as R105	
R135	RFC, 100Ω, ±5%, 1/4w	R-1458
R201	RFC, 150kΩ, ±10%, 1/2w	R-98
R202	RVDC, 50kΩ, ±20%, 1/4w	R-1768
R203	RFC, 33kΩ, ±10%, 1/2w	R-36
R204	RFC, 1kΩ, ±10%, 1/2w	R-18
R205	RVDC, 100kΩ, ±20%, 1/4w	R-1772
R206	RFC, 10kΩ, ±10%, 1/2w	R-23
R207	RVDC, 25kΩ, ±20%, 2w	R-1771
R208	RFC, 39kΩ, ±10%, 1/2w	R-26
R209	RFC, 47kΩ, ±10%, 1/2w	R-27
R210	RFC, 3.9kΩ, ±10%, 1/2w	R-40
R211	Same as R204	
R212	Same as R204	
R213	RVDC, 1kΩ, ±20%, 1/4w	R-1770
R214	RFC, 8.2kΩ, ±10%, 1/2w	R-43
R215	RFC, 4.7kΩ, ±10%, 1/2w	R-21
R216	Same as R204	
R217	RVDC, 10kΩ, ±20%, 1/4w	R-1769
R218	RFC, 22kΩ, ±10%, 1/2w	R-24
R219	Same as R207	
R220	RFC, 100kΩ, ±10%, 1/2w	R-28
R221	RFC, 1.8kΩ, ±10%, 1/2w	R-19
R222	Same as R209	
R223	Same as R204	
R224	RFC, 27kΩ, ±10%, 1/2w	R-25
R225	Same as R204	
R226	RFC, 100Ω, ±10%, 1/2w	R-15
R227	Same as R217	
R228	RFC, 2.7kΩ, ±10%, 1/2w	R-114
R229	Same as R228	
R230	Same as R215	
R231	Same as R206	
R232	RFC, 7.5kΩ, ±10%, 1/2w	R-151
R301	RFC, 820Ω, ±5%, 2w	R-334
R302	Same as R301	

TABLE 5-2 (Cont)

R303	RFC, 1.2kΩ, ±5%, 2w	R-336
R304	RFC, 1.3kΩ, ±5%, 2w	R-337
R305	RFC, 1kΩ, ±5%, 2w	R-335
R306	RFC, 620Ω, ±5%, 1w	R-241
R307	RFC, 360Ω, ±5%, 1/2w	R-79
R308	RFC, 270Ω, ±5%, 1/2w	R-97
R309	RFC, 150Ω, ±5%, 1/4w	R-1475
R310	RFC, 75Ω, ±5%, 1/4w	R-1456
R311	RFC, 91Ω, ± 5%, 1/4w	R-1499
R312	RFC, 270Ω, ±5%, 1/4w	R-1459
R313	Same as R312	
R314	RFC, 180Ω, ±5%, 1/4w	R-1458
R315	Same as R309	
R351	RFC, 75kΩ, ±5%, 1/4w (SC)	R-1409
R352	RFC, 270kΩ, ±5%, 1/4w	R-1466
R353	RFC, 100kΩ, ±5%, 1/4w	R-1413
R354	RFC, 39kΩ, ±5%, 1/4w	R-1420
R355	RFC, 27kΩ, ±5%, 1/4w	R-1403
R356	RFC, 56kΩ, ±5%, 1/4w	R-1407
R357	RFC, 15kΩ, ±5%, 1/4w	R-1411
R358	RFC, 18kΩ, ±5%, 1/4w	R-1444
R359	RFC, 5.6 kΩ, ±5%, 1/4w	R-1480
R360	RFC, 4.7 kΩ, ±5%, 1/4w	R-1447
R361	Same as R312 (SC)	
R401	Same as R214	
R402	RFC, 56kΩ, ±5%, 1/4w	R-1425
R403	RFC, 100kΩ, ±10%, 1/4w	R-1424
R404	Same as R403	
R405	RFC, 10kΩ, ±10%, 1/4w	R-1494
R406	Same as R131	
R407	RFC, 10Ω, ±10%, 1/4w	R-1483
R408	Same as R407	
R501	RFC, 82kΩ, ±10%, 1/2w	R-107
R502	RFC, 68kΩ, ±10%, 1/2w	R-51
R503	Same as R226	
R504	RFC, 330Ω, ±10%, 1/2w	R-17
R701	RFC, 68Ω, ±10%, 1/2w	R-14
R702	RFC, 75Ω, ±10%, 1/2w	R-152
R703	Same as R701	
R704	Same as R206	
R705	RFC, 220Ω, ±10%, 1/2w	R-39
R706	RFC, 680kΩ, ±10%, 1/2w	R-30
R707	Same as R215	

TABLE 5-2 (Cont)

R801	RFC, 5.6kΩ, ±10%, 1/8w	R-1822
R802	Same as R801	
R803	RFC, 120Ω, ±5%, 1/4w	R-1497
R901	RFC, 150Ω, ±10%, 1/4w	R-1487
R902	Same as R801	
R903	Same as R801	
T101	Transformer	T-26

ABBREVIATION CODE

CFC	Capacitor, Fixed, Ceramic
CFCF	Capacitor, Fixed, Ceramic, Feed-Thru
CFE	Capacitor, Fixed, Electrolytic
CFM	Capacitor, Fixed, Mica
CFO	Capacitor, Fixed, Oil
CFP	Capacitor, Fixed, Paper
CFT	Capacitor, Fixed, Teflon
CVA	Capacitor, Variable, Air
DS	Diode, Semiconductor
IF	Inductor, Fixed
IV	Inductor, Variable
LI	Lamp, Incandescent
NA	Not Assigned
PC	Plug, Cable
PO	Part of
RFC	Resistor, Fixed, Composition
RFCF	Resistor, Fixed, Carbon Film
RFWW	Resistor, Fixed, Wirewound
RJ	Receptacle, Jack
RVC	Resistor, Variable, Composition
RVDC	Resistor, Variable, Dual Composition
RVDWW/C	Resistor, Variable, Dual, Wirewound/Composition
RVWW	Resistor, Variable, Wirewound
SC	Subject to change
SWT	Switch, Toggle
TC	Terminator, Cable
TD	Time Delay
TE	Tube, Electron
TP	Transformer, Power
TR	Transistor

SECTION VI

SCHEMATIC DIAGRAMS

6-1. GENERAL.

6-2. This section provides the complete set of schematic diagrams required for maintenance of the VR-50M PLUG-IN SWEEP GENERATOR.

6-3. The following schematics are included in this manual:

a.	Power Supply and Leveler	SC008-0030	Figure 6-1
b.	Sweep Drive	SC008-0031	Figure 6-2
c.	Sweep Oscillator	SB008-0032	Figure 6-3
d.	Marker Power	SB008-0033	Figure 6-4
e.	Shaper	SB008-0034	Figure 6-5
f.	Variable Marker Oscillator and Mixer	SC008-0035	Figure 6-6

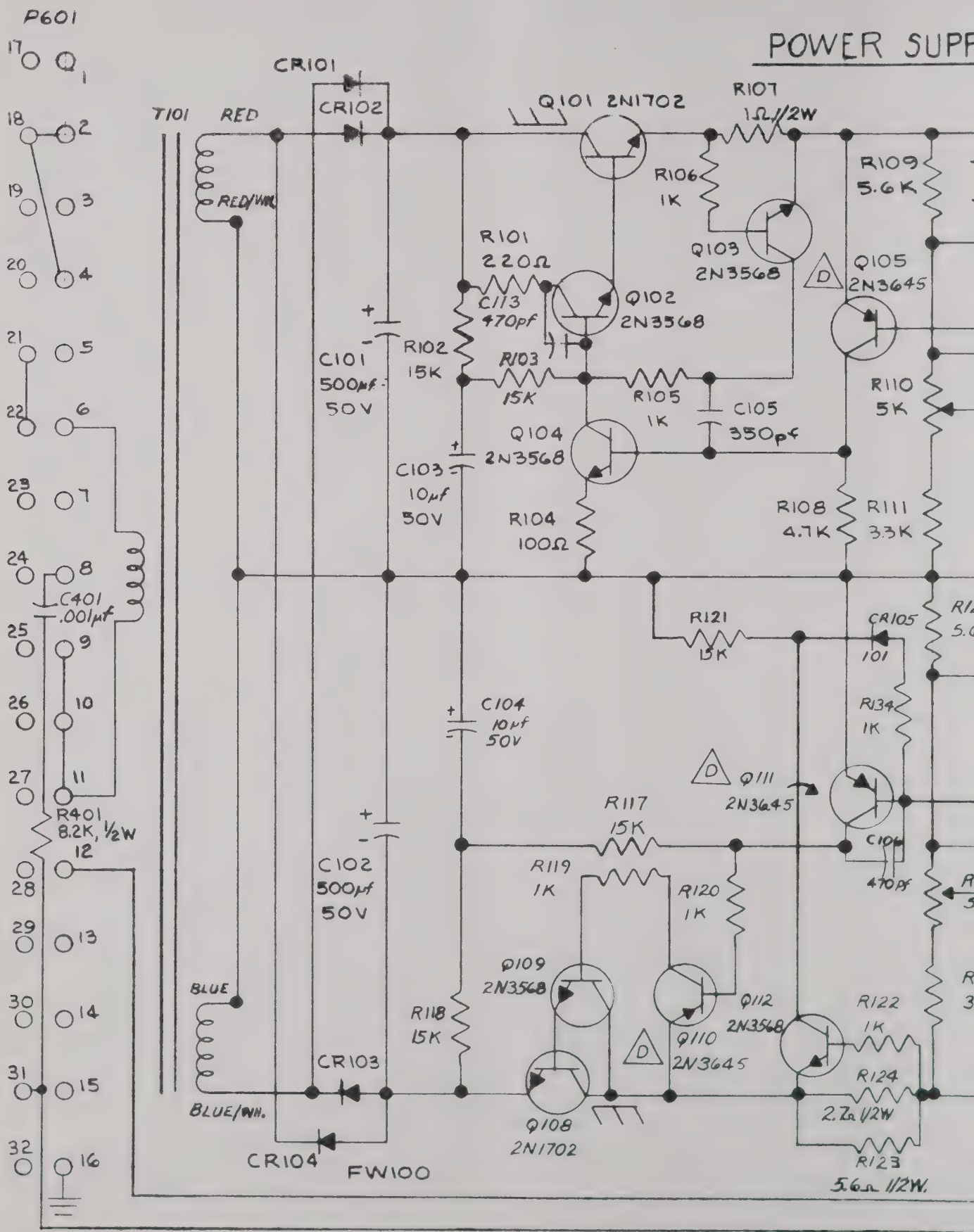
6-4. All resistors are 1/2 watt ±10% and are shown in ohms unless otherwise specified.

6-5. All capacitors are shown in picofarads (pf) unless otherwise specified.

6-6. All coils are shown in microhenries (μh) unless otherwise specified.

6-7. All starred values shown are subject to change.

POWER SUPP


P601
17
Q1
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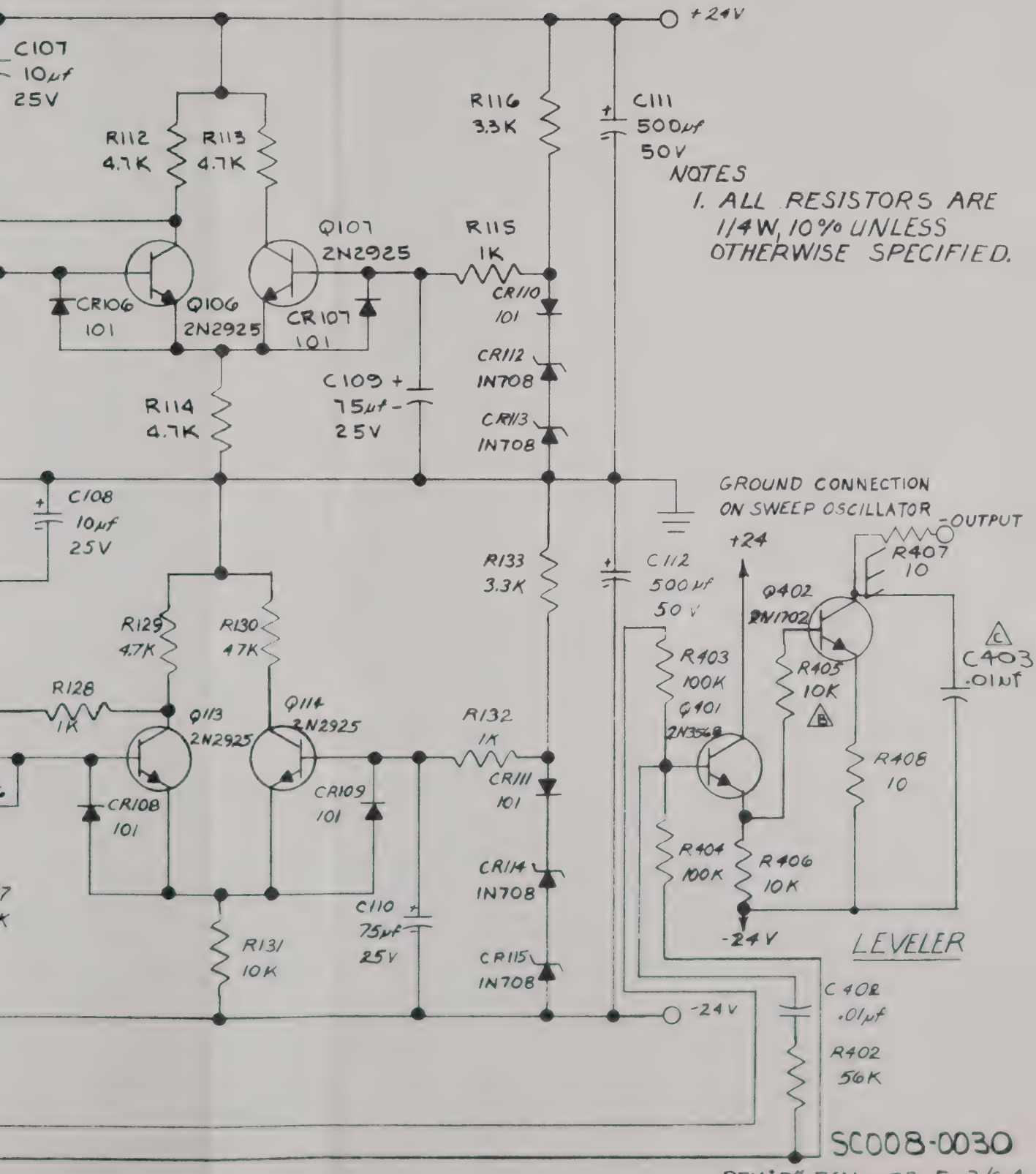
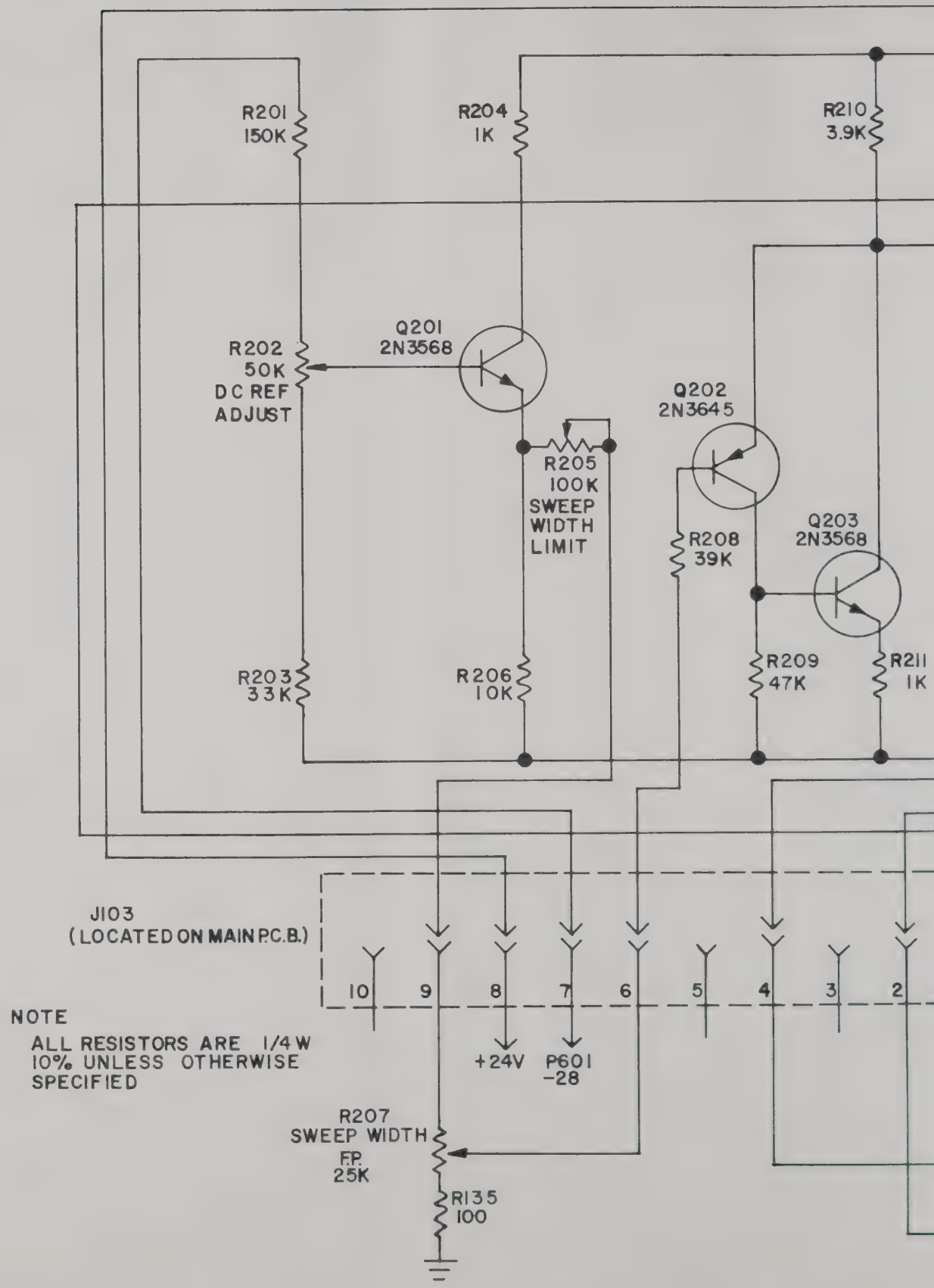
9
26
10
27
11
12
28
29
13
30
14
31
15
32
16
C401
.001µf
R401
8.2K, ½W
T101
RED
RED/WHT
BLUE
BLUE/WH.
CR101
CR102
CR103
CR104
FW100
C101
500µf
50V
C102
500µf
50V
C103
10µf
50V
C104
10µf
50V
Q101 2N1702
Q102
2N3568
Q103
2N3568
Q104
2N3568
Q105
2N3645
Q108
2N1702
Q109
2N3568
Q110
2N3645
Q111
2N3645
Q112
2N3568
R101
220Ω
R102
15K
R103
15K
R104
100Ω
R105
1K
R106
1K
R107
1Ω 1/2W
R108
4.7K
R109
5.6K
R110
5K
R111
3.3K
R117
15K
R118
15K
R119
1K
R120
1K
R121
15K
R122
1K
R123
5.6Ω 1/2W.
R124
2.2Ω 1/2W
C105
350pf
C106
470pf
C113
470pf
CR105
101
R134
1K
D
D
D

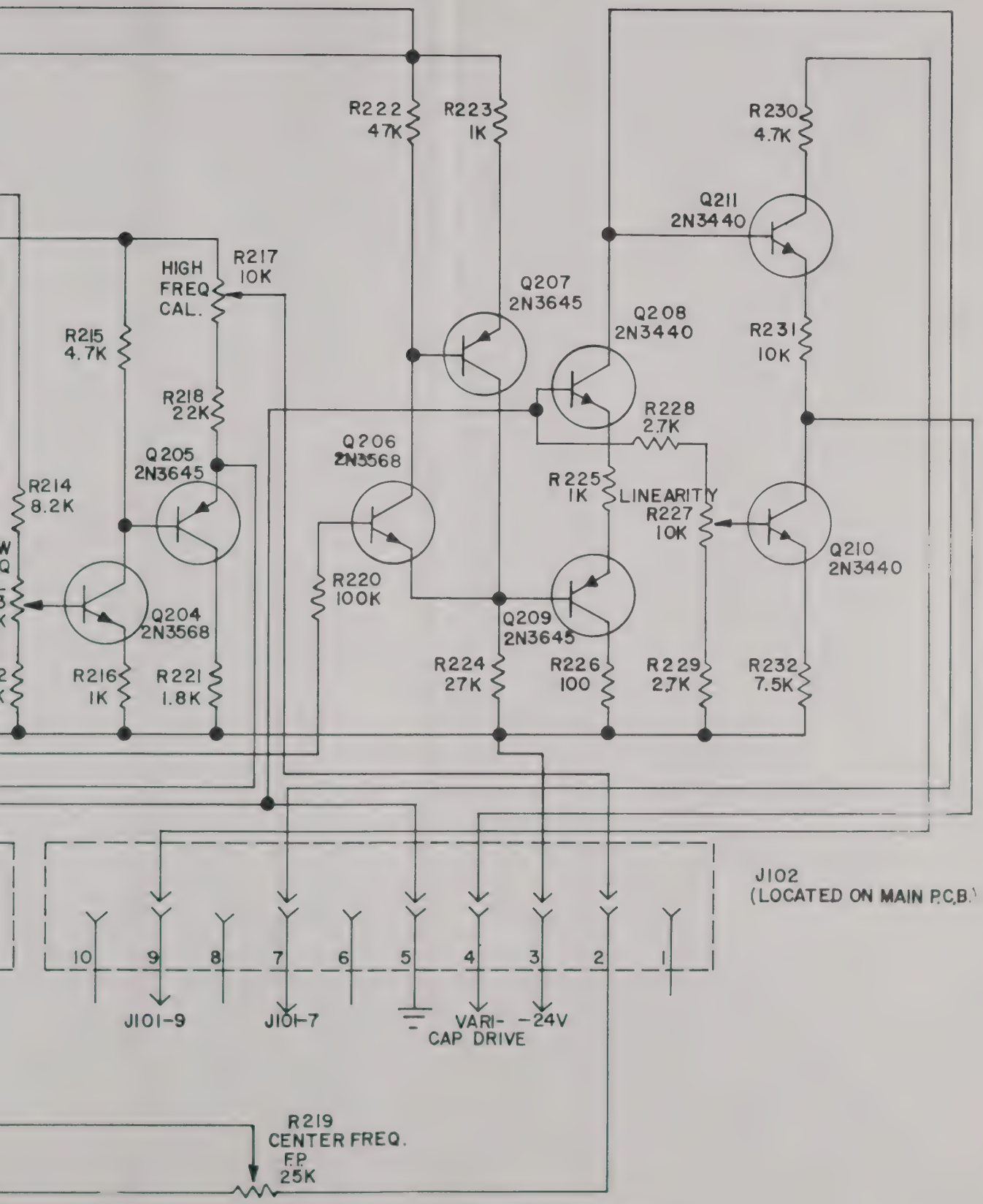
Y



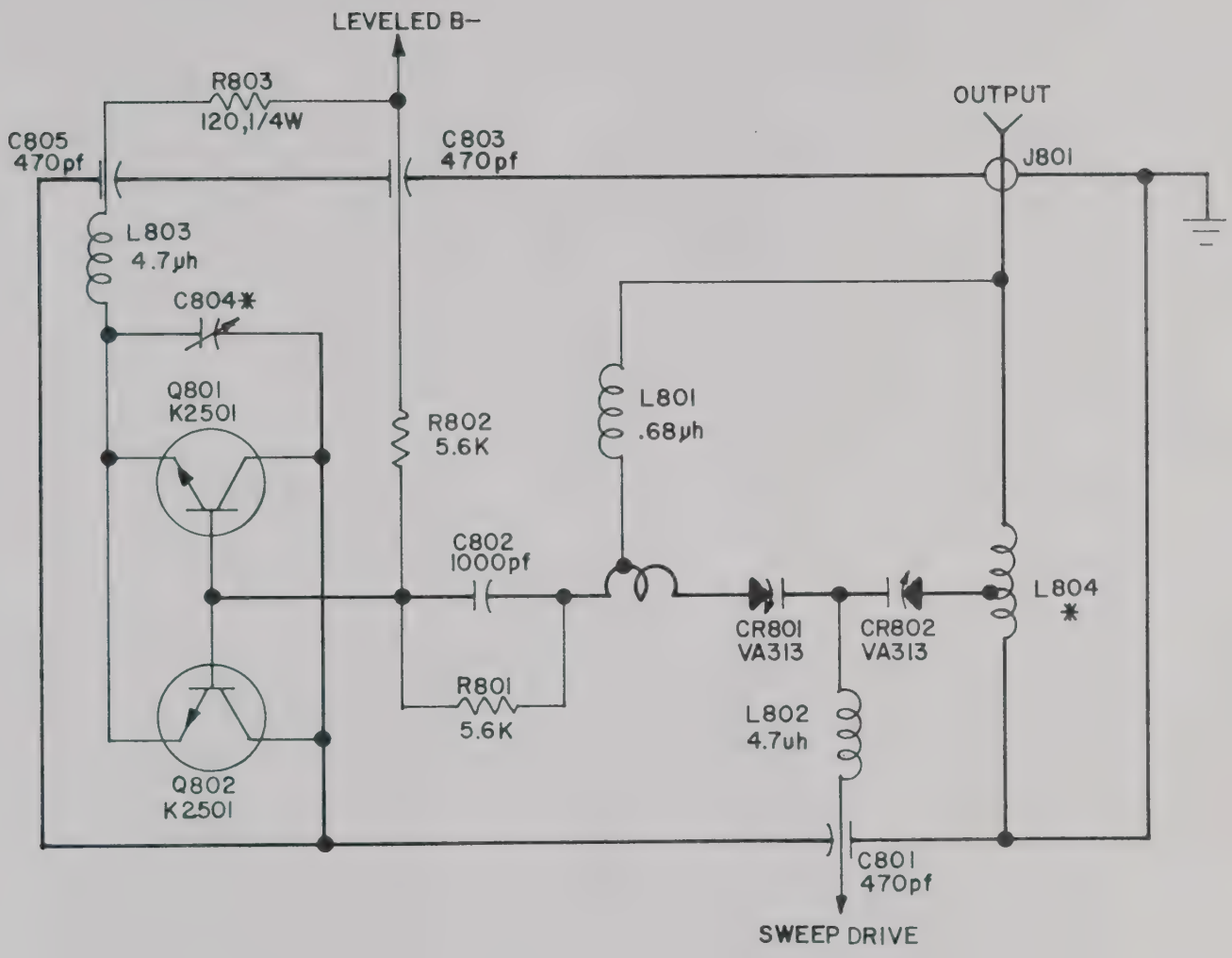
SC008-0030

REV "D" ECN 1673 6-3/6-4


R201
150K
R204
1K
R210
3.9K
R202
50K
DC REF
ADJUST
Q201
2N3568
Q202
2N3645
R205
100K
SWEEP
WIDTH
LIMIT
Q203
2N3568
R208
39K
R203
33K
R206
10K
R209
47K
R211
1K
J103
(LOCATED ON MAIN P.C.B.)
10
9
8
7
6
5
4
3
2
+24V
P601
-28
NOTE
ALL RESISTORS ARE 1/4 W
10% UNLESS OTHERWISE
SPECIFIED
R207
SWEEP WIDTH
F.P.
25K
R135
100



Sweep Drive Schematic



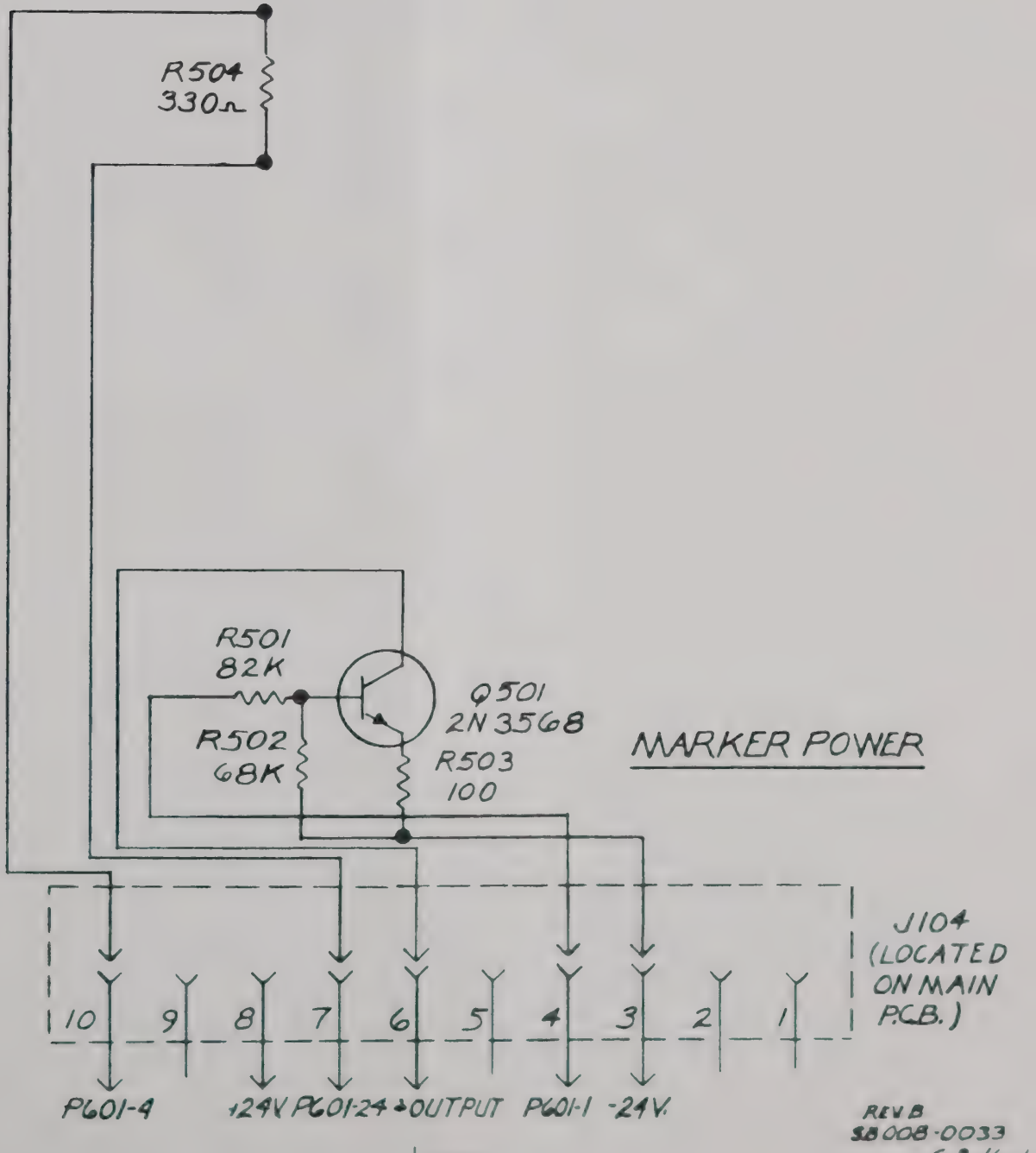
NOTES:

ALL RESISTORS ARE 1/8 W, ±10%
UNLESS OTHERWISE SPECIFIED

Sweep Oscillator

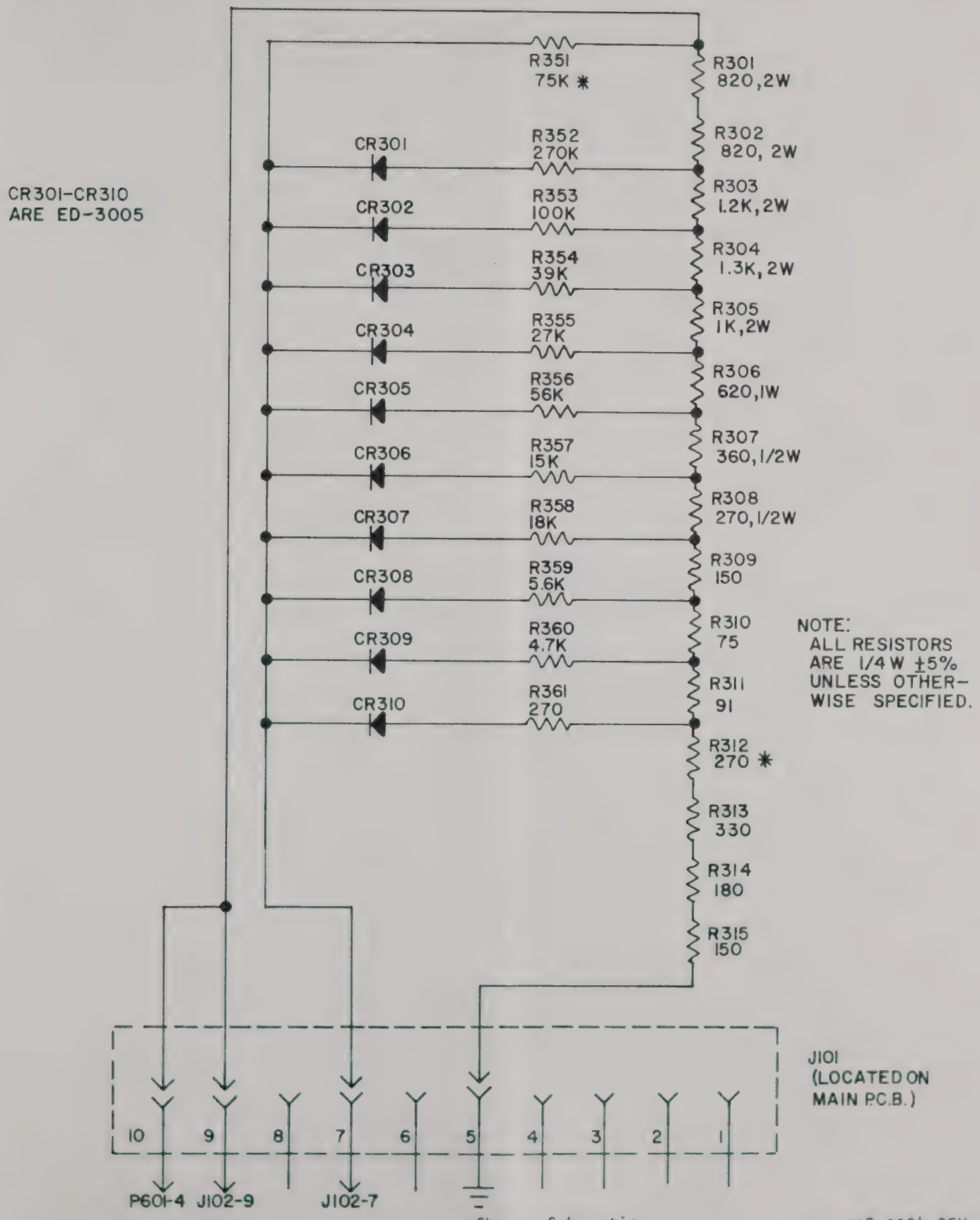
REV. B
SB008-0032
6-7/6-8

FOLD



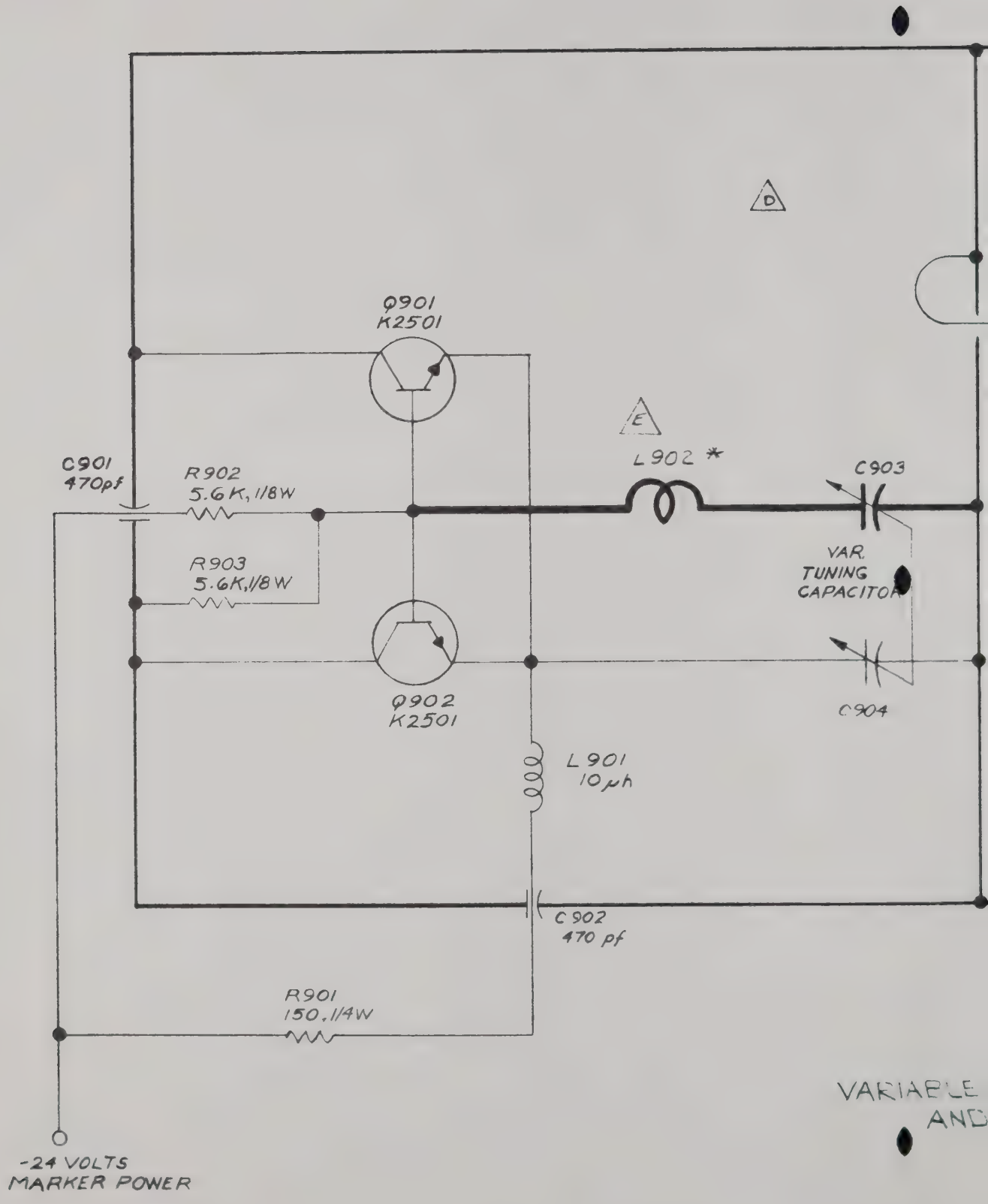
REV B
SB008-0033
6-9 16-1

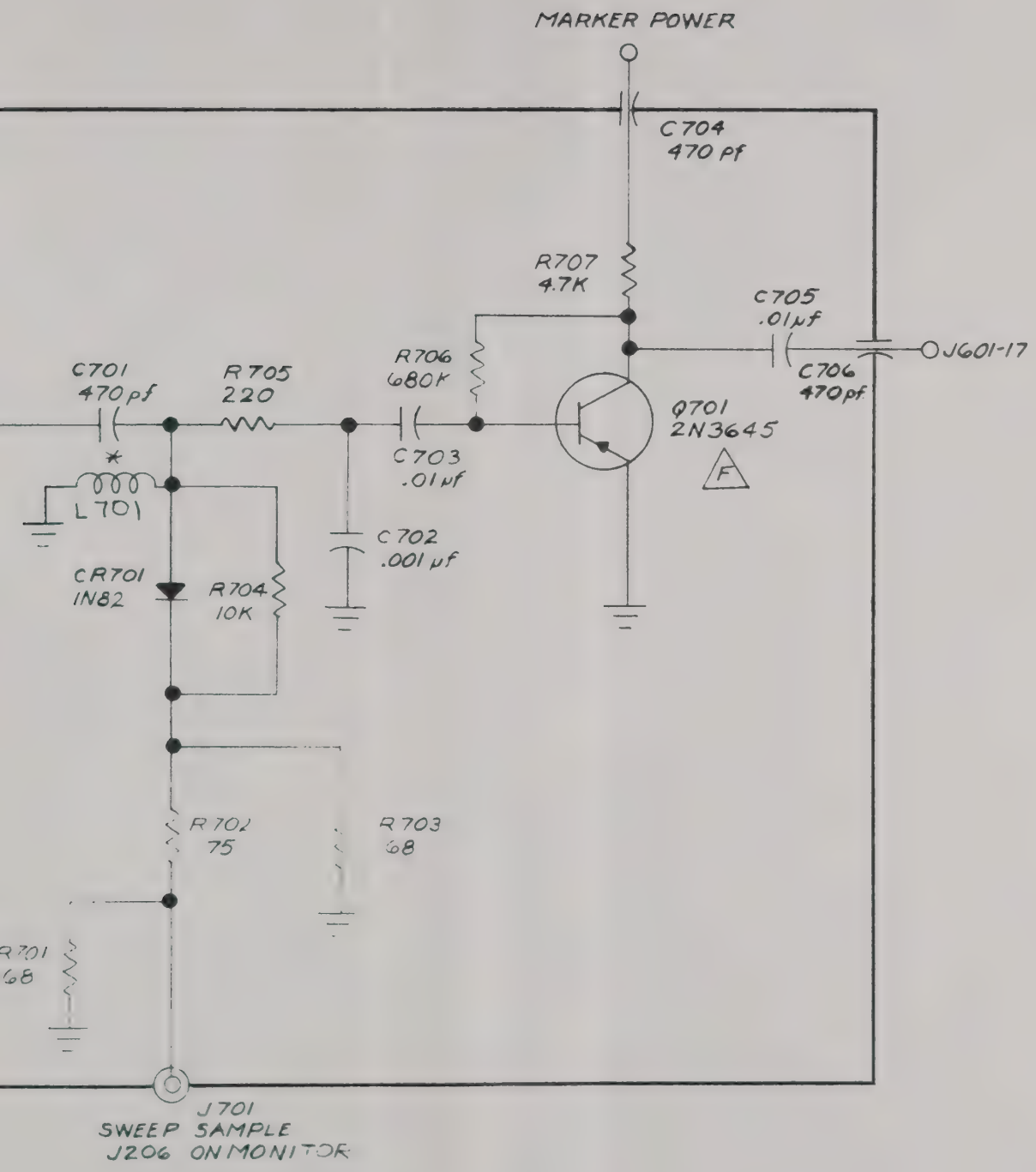
FOLD



Shaper Schematic

SB 008-0034 REV. C
6-11/6-12


D
Q901
K2501
E
L902 *
C903
C901
470pf
R902
5.6K, 1/8W
VAR.
TUNING
CAPACITOR
R903
5.6K, 1/8W
Q902
K2501
C904
L901
10 μh
C902
470 pf
R901
150, 1/4W
VARIABLE
AND
-24 VOLTS
MARKER POWER



NOTE

ALL RESISTORS ARE 1/2 WATT
UNLESS OTHERWISE SPECIFIED.

MARKER OSCILLATOR
MIXER

SC557035
REV. F ECN 1673
040 SC 008-0035
6-13/6-14

Amberg
ESSELTE
55811
MADE IN U.S.A.
0 78787 55811 3